

## WHAT IS CLAIMED IS:

- 1 1. An optical amplifying apparatus comprising:
  - 2 a plurality of pumping sources generating
  - 3 pumping light beams at different wavelengths;
  - 4 a Raman amplification medium receiving the
  - 5 pumping light beams from said pumping sources to
  - 6 amplify a main signal light beam by using stimulated
  - 7 Raman scattering phenomenon due to said pumping light
  - 8 beams;
  - 9 a rare-earth-doped optical amplification
  - 10 medium receiving said main signal light beam amplified
  - 11 by said Raman amplification medium to further amplify
  - 12 said main signal light beam; and
  - 13 a pumping light introducing means
  - 14 introducing a part or all of a pumping light beam at
  - 15 a specific wavelength of said pumping light beams as
  - 16 a pumping light beam for said rare-earth-doped optical
  - 17 amplification medium to said rare-earth-doped
  - 18 optical amplification medium.
- 1 2. The optical amplifying apparatus according to claim
- 2 1, wherein said pumping light introducing means is a
- 3 reflection-type fiber grating disposed between said
- 4 Raman amplification medium and said rare-earth-doped
- 5 optical amplification medium to reflect a part of said
- 6 pumping light beam at said specific wavelength to said

7 rare-earth-doped optical amplification medium, and  
8 transmitting a rest of said pumping light beam to said  
9 Raman amplification medium.

1 3. The optical amplifying apparatus according to claim  
2, wherein said pumping light introducing means  
3 introduces a pumping light beam at a longer wavelength  
4 as said pumping light beam at said specific wavelength  
5 to said rare-earth-doped optical amplification  
6 medium.

1 4. The optical amplifying apparatus according to claim  
2, wherein said pumping sources intensity-modulate  
3 said pumping light beams according to monitoring  
4 control information to be transmitted.

1 5. The optical amplifying apparatus according to claim  
2 1, wherein said pumping light introducing means is an  
3 optical coupler disposed between said Raman  
4 amplification medium and said rare-earth-doped  
5 optical amplification medium to split said pumping  
6 light beam at said specific wavelength, introducing  
7 a part of said pumping light beam at said specific  
8 wavelength to said rare-earth-doped optical  
9 amplification medium, and introducing a rest of said  
10 pumping light beam to said Raman amplification medium.

1 6. The optical amplifying apparatus according to claim  
2 5, wherein said pumping light introducing means  
3 introduces a pumping light beam at a longer wavelength  
4 as said pumping light beam at said specific wavelength  
5 to said rare-earth-doped optical amplification  
6 medium.

1 7. The optical amplifying apparatus according to claim  
2 5, wherein said pumping sources intensity-modulate  
3 said pumping light beams according to monitoring  
4 control information to be transmitted.

1 8. The optical amplifying apparatus according to claim  
2 1, wherein said pumping light introducing means  
3 introduces a pumping light beam at a longer wavelength  
4 as said pumping light beam at said specific wavelength  
5 to said rare-earth-doped optical amplification  
6 medium.

1 9. The optical amplifying apparatus according to claim  
2 8, wherein said pumping sources intensity-modulate  
3 said pumping light beams according to monitoring  
4 control information to be transmitted.

1 10. The optical amplifying apparatus according to  
2 claim 1, wherein said pumping sources  
3 intensity-modulate said pumping light beams

4 according to monitoring control information to be  
5 transmitted.

1 11. An optical amplifying apparatus comprising:  
2 a plurality of counterpropagating pumping  
3 sources generating pumping light beams at different  
4 wavelengths;

5 a copropagating pumping source generating a  
6 pumping light beam at a specific wavelength identical  
7 to at least any one of said wavelengths of said pumping  
8 light beams generated by said counterpropagating  
9 pumping sources;

10 a Raman amplification medium receiving  
11 pumping light beams from said counterpropagating  
12 pumping sources from one direction and receiving said  
13 pumping light beam from said copropagating pumping  
14 source from other direction to amplify a main signal  
15 light beam by using stimulated Raman scattering  
16 phenomenon due to said pumping light beams from said  
17 both directions;

18 a rare-earth-doped optical amplification  
19 medium receiving said main signal light beam amplified  
20 by said Raman amplification medium to further amplify  
21 said main signal light beam; and

22 a pumping light introducing means  
23 introducing a part or all of said pumping light beam  
24 at said specific wavelength of said pumping light

25   beams from said counterpropagating pumping sources as  
26   a pumping light beam for said rare-earth-doped optical  
27   amplification medium to said rare-earth-doped  
28   optical amplification medium, and transmitting at  
29   least said pumping light beam at said specific  
30   wavelength from said copropagating pumping source as  
31   another pumping light beam for said rare-earth-doped  
32   optical amplification medium.

1   12. The optical amplifying apparatus according to  
2   claim 11, wherein said pumping light introducing means  
3   is a reflection-type fiber grating disposed between  
4   said Raman amplification medium and said  
5   rare-earth-doped optical amplification medium to  
6   reflect a part of said pumping light beam at said  
7   specific wavelength to said rare-earth-doped optical  
8   amplification medium, transmitting a rest of said  
9   pumping light beam to said Raman amplification medium,  
10   and transmitting said pumping light beam from said  
11   copropagating pumping source to said  
12   rare-earth-doped optical amplification medium.

1   13. The optical amplifying apparatus according to  
2   claim 12, wherein said pumping light introducing means  
3   introduces a pumping light beam at a longer wavelength  
4   as said pumping light beam at said specific wavelength  
5   to said rare-earth-doped optical amplification

6 medium.

1 14. The optical amplifying apparatus according to  
2 claim 12, wherein said pumping sources  
3 intensity-modulate said pumping light beams  
4 according to monitoring control information to be  
5 transmitted.

1 15. The optical amplifying apparatus according to  
2 claim 11, wherein said pumping light introducing means  
3 is an optical coupler disposed between said Raman  
4 amplification medium and said rare-earth-doped  
5 optical amplification medium to split said pumping  
6 light beam at said specific wavelength, introducing  
7 a part of said pumping light beam at said specific  
8 wavelength to said rare-earth-doped optical  
9 amplification medium, introducing a rest of said  
10 pumping light to said Raman amplification medium, and  
11 transmitting a pumping light beam from said  
12 copropagating pumping source to said  
13 rare-earth-doped optical amplification medium.

1 16. The optical amplifying apparatus according to  
2 claim 15, wherein said pumping light introducing means  
3 introduces a pumping light beam at a longer wavelength  
4 as said pumping light beam at said specific wavelength  
5 to said rare-earth-doped optical amplification

6 medium.

1 17. The optical amplifying apparatus according to  
2 claim 15, wherein said pumping sources  
3 intensity-modulate said pumping light beams  
4 according to monitoring control information to be  
5 transmitted.

1 18. The optical amplifying apparatus according to  
2 claim 11, wherein said pumping light introducing means  
3 introduces a pumping light beam at a longer wavelength  
4 as said pumping light beam at said specific wavelength  
5 to said rare-earth-doped optical amplification  
6 medium.

1 19. The optical amplifying apparatus according to  
2 claim 18, wherein said pumping sources  
3 intensity-modulate said pumping light beams  
4 according to monitoring control information to be  
5 transmitted.

1 20. The optical amplifying apparatus according to  
2 claim 11, wherein said pumping sources  
3 intensity-modulate said pumping light beams  
4 according to monitoring control information to be  
5 transmitted.